
Montana Fish, Wildlife & Parks
UNIVERSITY OF MONTANA
Top-down and Bottom-up Effects on Elk Survival and Recruitment in the Bitterroot Valley
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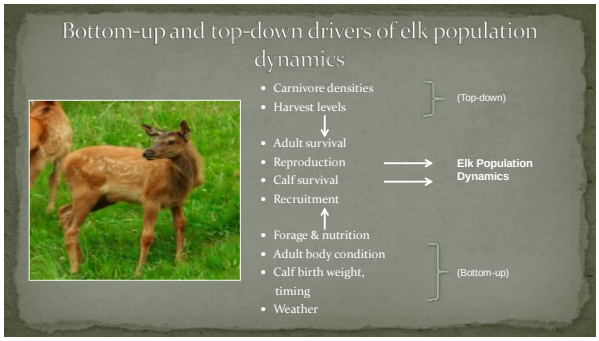
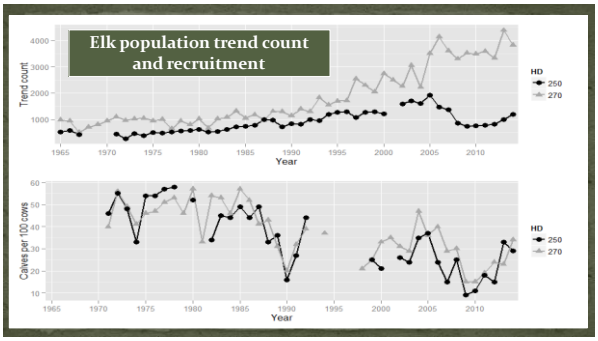
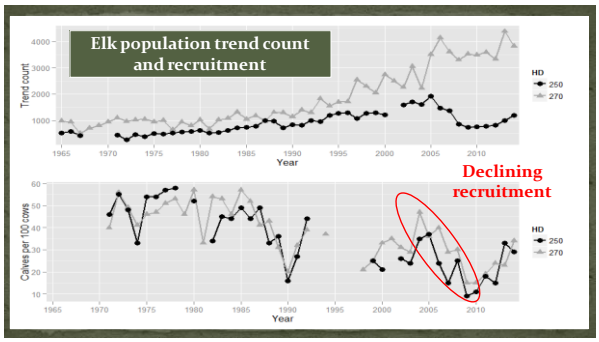
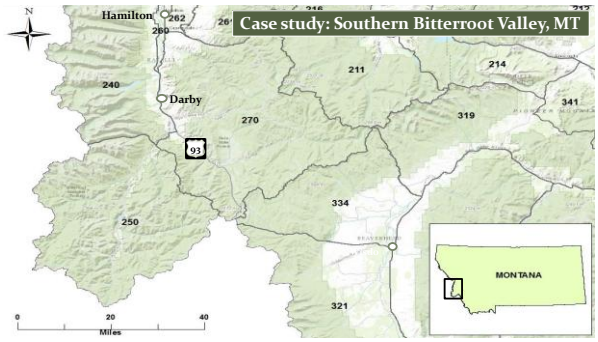
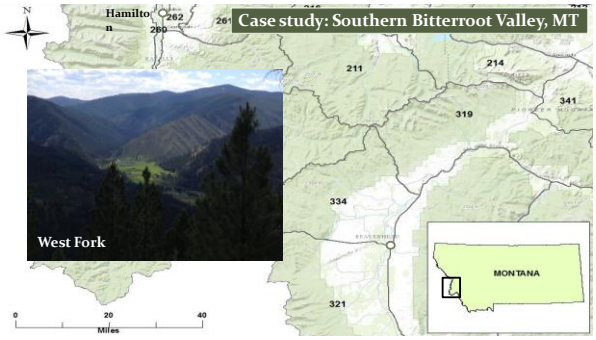
Bitterroot Elk Project Overview
Evaluate bottom-up and top-down effects on elk population dynamics in the Bitterroot Valley.
Understand factors contributing to declines in Bitterroot Valley elk populations.

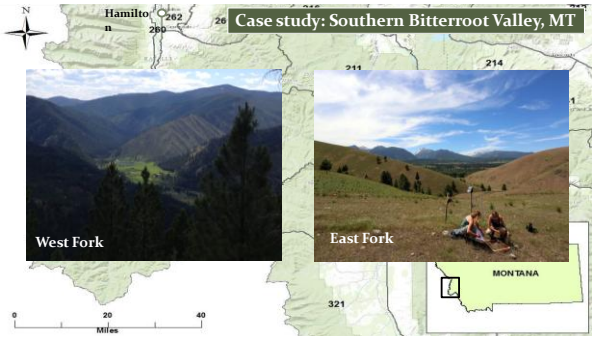

Bottom-up and top-down drivers of elk population dynamics
Carnivore densities
Harvest levels
(Top-down)
Adult survival
Reproduction
Calf survival
Recruitment
Elk Population Dynamics
Forage & nutrition
Adult body condition
Calf birth weight, timing
Weather
(Bottom-up)


Elk population trend count and recruitment
Trend count
Year
HD
250
270
Calves per 100 cows


Elk population trend count and recruitment
Declining recruitment
Trend count
Year
HD
250
270
Calves per 100 cows


Case study: Southern Bitterroot Valley, MT
Hamilton
Darby
93
240
270
211
214
341
319
334
250
321
MONTANA
Miles

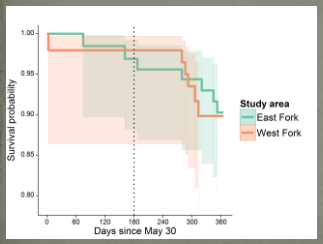




Adult female collaring and survival

- 126 adult females captured, collared and sampled:
  - 44 in winter 2010/2011
  - 40 in winter 2011/2012
  - 42 in winter 2012/2013
- 1 million + GPS locations
  - seasonal habitat use
  - migratory behaviors
  - herd delineations

Adult female survival

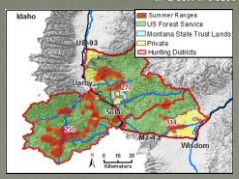


- Overall survival = 0.90
  - Somewhat low for minimally hunted population
- Majority of mortalities occurred March - May

Adult female raw counts of morality sources

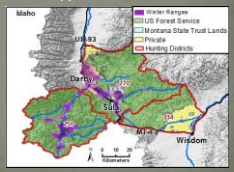
Mortality Source	WF	EF	Total
Lion	2	1	3
Wolf	1	1	2
Unknown	2	1	3
Natural, non-predation	1	3	4
Human caused	0	1	1
Total	6	7	13

Seasonal Ranges



Summer ranges:
- Higher elevation tributaries and forested areas
- Primarily public lands outside of Big Hole

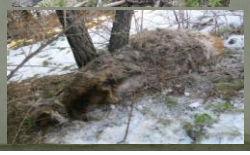
Winter ranges:
- Lower elevation foothills and valley bottoms
- Primarily private lands



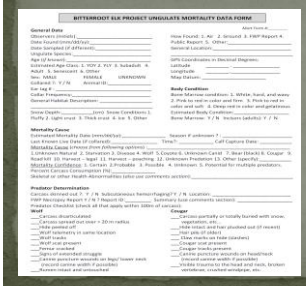
Migratory Behavior

Area	n	Average distance (km)	Average spring start	Average fall start	Average time on summer range (days)
West Fork	13	11.96	13 June	29 August	52.67
East Fork	46	20.55	6 May	8 October	138.33

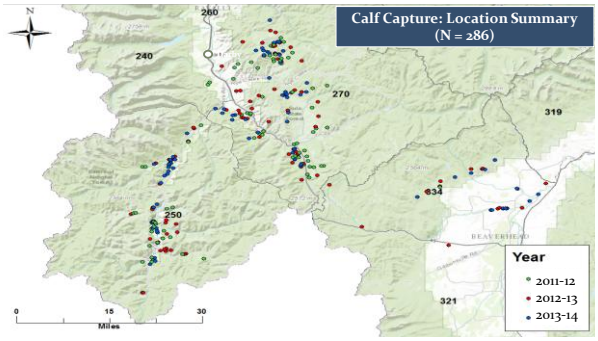
Calf survival and cause-specific mortality

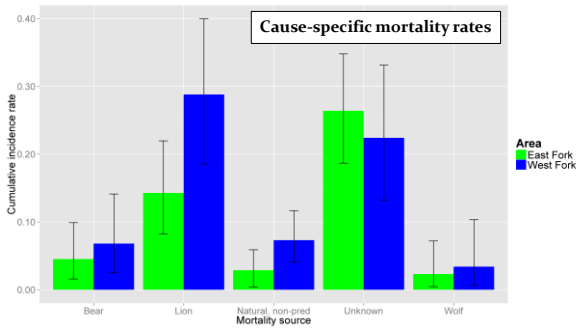


Calf Monitoring

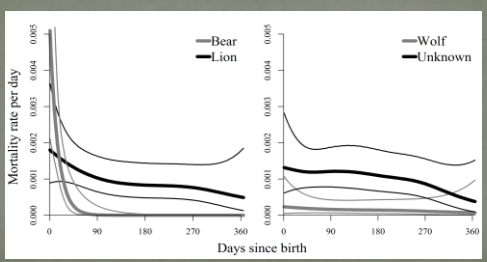

BITTERROOT ELK PROJECT UNGULATE MORTALITY DATA FORM

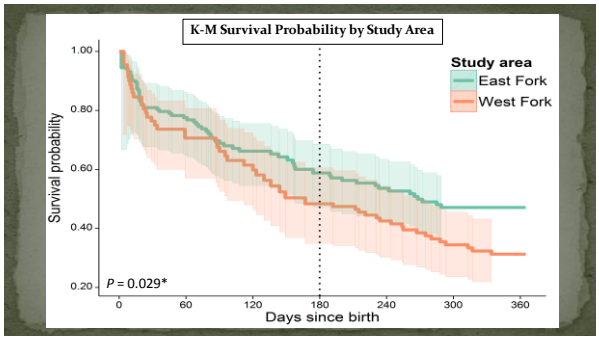
- Daily signal checks 1st 3 months
- 3 days/wk remainder
- Detailed necropsy reports, photographs, and DNA evidence

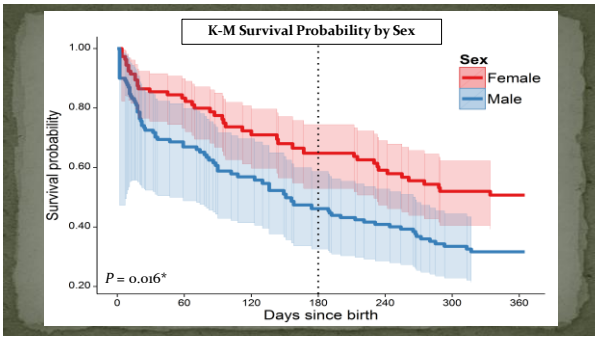




Daily probability of mortality (0-365 days)



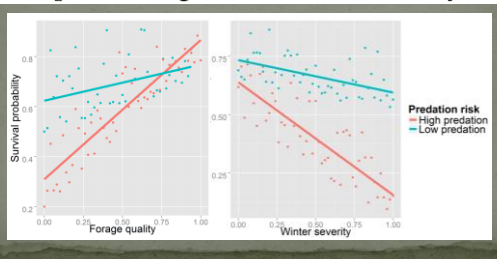




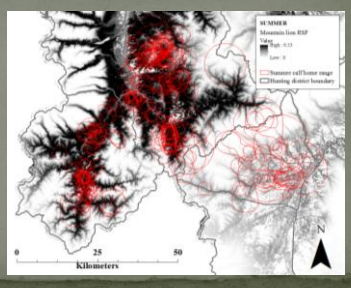
Basic Calf Survival Summary

- Overall calf survival = 0.41
  - Range from other studies ~ 0.31 - .84
- Male survival lower than female
  - 0.32 (male) vs. 0.50 (female)
- West Fork survival lower than East Fork
  - 0.32 (WF) vs. 0.47 (EF)
- Summer survival lower than winter survival
  - 0.55 (summer) vs. 0.74 (winter)
- Mountain lions = primary single mortality cause
  - Regardless of area, season or year

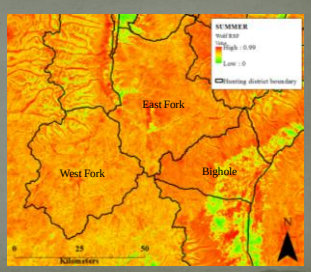
Does the effect of predation on elk calf survival depend on forage or winter weather severity?



Summer Mountain Lion Predation Risk



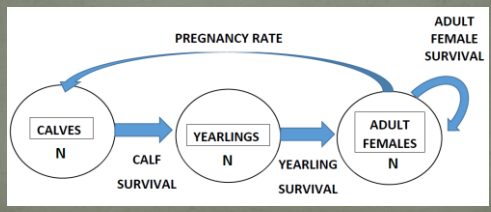
Summer Wolf Predation Risk

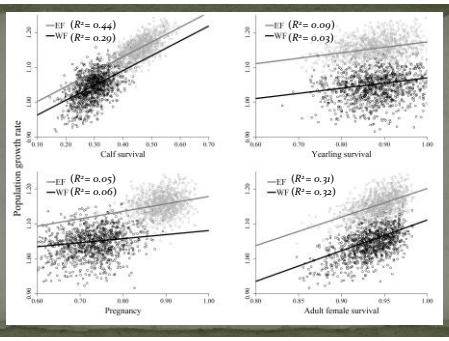


Calf Survival Spatial Risk Summary

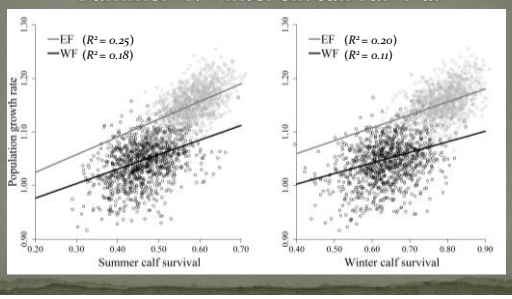
- Mountain lion predation risk explains calf survival in both seasons
- No appreciable effect of wolf predation risk
- No evidence that calf vulnerability to predation depended on forage availability in summer
- Elk calf vulnerability to predation increased with greater accumulation of winter precipitation

Elk population modeling

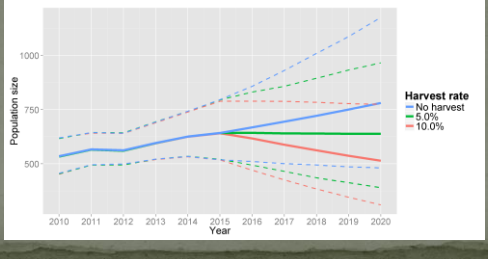




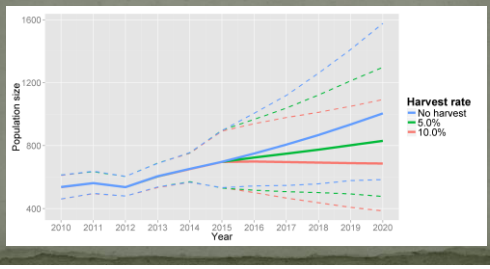
Summer vs. winter elk calf survival



Simulating mean calf survival and harvest



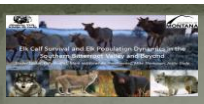
Simulating 40% calf survival and harvest



Population dynamics summary

- Summer calf survival only slightly more important than winter for elk population dynamics
- Elk population growth is expected to respond strongest to increases in calf and adult female survival
- Increasing calf survival in less productive herds may create hunting opportunity in populations with restricted harvest

Bottom-up effects of forage quality on elk in the Bitterroot Valley, Montana

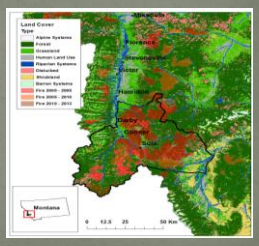


Bitterroot Valley, MT

- Habitat drives ungulate populations
  - Carnivores do not change this basic ecological principle.
- Wildfire, timber harvest, development have landscape-scale impacts on habitat

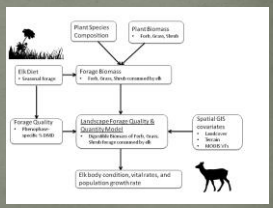
Bitterroot Valley, MT

- Habitat drives ungulate populations
  - Carnivores do not change this basic ecological principle.
- Wildfire, timber harvest, development have landscape-scale affects on habitat
  - In south Bitterroot wildfire affects habitat

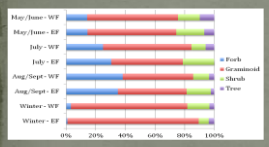


Objectives

- To develop a landscape level elk nutrition model
  - Integrated ground based measurements and remote sensing data to estimate elk forage quality
- Relate elk forage quality to elk body condition and pregnancy rates



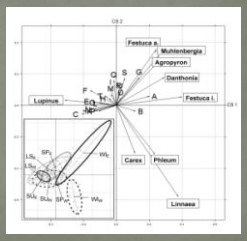
Elk diet



- Forage class composition similar between East Fork and West Fork elk herds.
- Identified 22 forage species that include 95% of the summer and winter diet.

Elk diet per herd

- Important differences in species composition in EF and WF elk diets
- Largest differences occurred in winter diet
  - WF elk eat more Carex, Alpine timothy, Twinflower
  - EF elk eat more Fescue, *Muhlenbergia, and Bluebunch wheatgrass*
- In summer EF elk ate more Lupine



Elk forage biomass

- Stratified sampling across 8 land cover types
- Sampled 235 sites during 15 July – 31 August, 2012-2103
- Recorded plant species composition and measured biomass along 40m transect
- Within forage classes, apportioned biomass to estimate species-specific biomass

Plant phenology

- To estimate phenology for each study area, we repeat sampled 29 'phenology' plots monthly from April – October.
- Estimated proportion of each forage species in each phenophase per study area during late-summer.

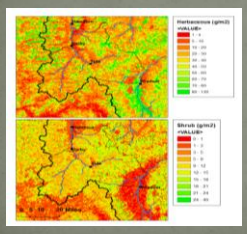
Elk forage quality

- Estimated late summer forage quality, measured in grams of digestible dry matter per m²
- This response variable integrated:
  1. Quality (DMD) of individual forage species in each phenophase
  2. Phenology of forage species per study area during late summer
  3. Biomass of forage species

Dry Matter Digestibility

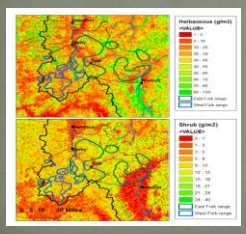
	New	Flowering	Fruiting	Mature	Cured	Average
Forb	63.49	64.38	56.15	55.93	39.44	59.51
Graminoid	32.85	32.79	29.72	30.46	23.97	27.55
Shrub	65.85	63.26	61.80	58.46	50.93	61.88

Elk forage quality



	Summer	
	Herbaceous (g/m^2)	Shrub (g/m^2)
Grassland	53.9	6.3
Shrubland	53.0	1.2
Dry Forest - Burn Age 1-5	19.9	3.5
Dry Forest - Burn Age 6-15	37.3	10.0
DryForest - Burn Age > 15	30.8	8.0
Wet Forest - Burn Age 1-5	35.4	3.5
Wet Forest - Burn Age 6-15	47.5	12.0
WetForest - Burn Age > 15	46.3	10.9

Elk forage quality



	East Fork Mean (g/m^2)	West Fork Mean (g/m^2)
Summer		
Herbaceous	42.4	31.6
Shrub	8.9	8.4
Winter		
Herbaceous	24.9	9.1
Shrub	2.4	2.1

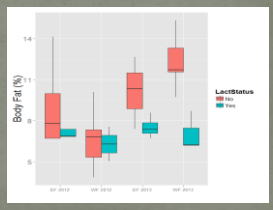
Elk forage quality

- What do these late summer nutritional differences mean in terms of elk vital rates and population level consequences?

	East Fork Mean (g/m^2)	West Fork Mean (g/m^2)
Summer		
Herbaceous	42.4	31.6
Shrub	8.9	8.4
Winter		
Herbaceous	24.9	9.1
Shrub	2.4	2.1

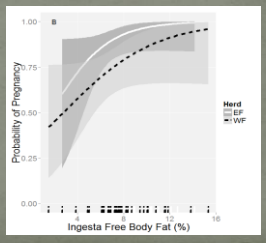
Elk body condition

- Fall body fat of lactating elk is lower in the West Fork than in the East Fork.



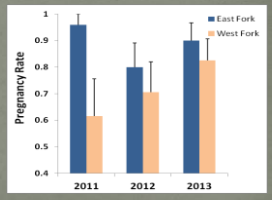
Elk body condition and pregnancy rate

- Fall body fat affects the probability of pregnancy

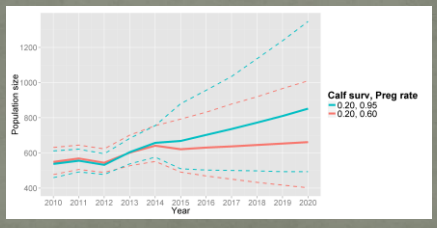


Elk pregnancy rate

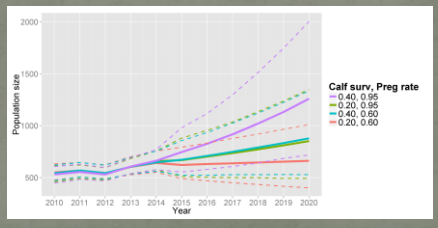
- Pregnancy rate is lower in the West Fork
- All years:
  - West Fork = 0.73
  - East Fork = 0.90



Population growth rate

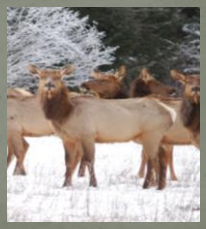


Population growth rate



Conclusions

- West Fork elk reproductive performance may be nutritionally limited
  - Evidence for this in lower forage availability and quality, low body condition, low pregnancy rates



Conclusions

- Nutritional limitation may predispose a herd to be susceptible to the effects of predation or harvest.
  - Herds in low quality habitats may be able to sustain only lower levels of predation or harvest than more productive herds.
  - To sustain elk populations in low productivity areas, managers may need a more aggressive approach to carnivore management, harvest management, and/or habitat management.

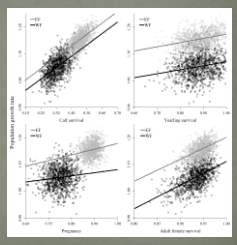
Conclusions

- These results highlight the importance of evaluating both top-down and bottom-up factors affecting elk population dynamics.

What do we do now?

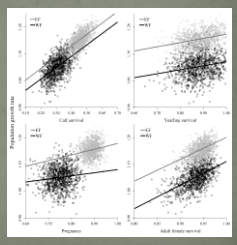
Management Recommendations

- Female survival and calf survival have stronger influence on population than pregnancy rate.
- Management actions focused on these vital rates are predicted to have most impact on population growth rate.



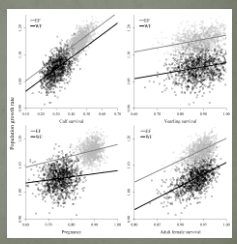
Management Recommendations

- Maintain adult female survival
  - Current adult survival is 0.90.
  - In WF, further reduction in survival could reduce population growth rate below 1.0.
  - In EF, the population could remain stable with small declines in survival.



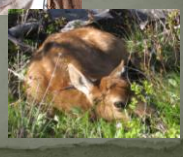
Management Recommendations

- Maintain/increase calf survival
  - Calf survival rates below 30% may result in population declines
    - Recruitment surveys in 2009-2011 predicted <10% calf survival
- If antlerless harvest occurs and female survival is reduced, need to further increase calf survival.



Future Plans and Goals

- Estimate mountain lion density in winter 2017 to evaluate the effects of lion harvest management on lion populations
  - Did changes in lion harvest result in changes in lion density?
- Estimate calf survival in 2016-2018 to evaluate the effects on lion harvest management on elk calf survival
  - Did changes in lion harvest increase elk calf survival?



Thank you!

- **Multiple partners and funders on the project**
- **Landowners & community members**
- **FWP staff, UM staff, field crews**